

Review on power generation scenario of India

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ABSTRACT

India is a major future consumer of electric power due to the rapid economic growth and large population. In this article, the present state and perspectives of using various energy sources in India for electric power generation are depicted as well as the main tools for promoting their development and utilization are highlighted. Wide spread use of coal and other fossil fuels have led to accumulation of the enormous amount of carbon dioxide and a resultant global warming in the earth's atmosphere. Use of renewable energy sources is one of the crucial components of the sustainable development. The scope of renewable energy sources for increasing the power generation capacity to meet the demand of Indian needs are described broadly.

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1. Introduction

Energy is the most important factor in wealth generation and economic and social development. Based on historical data, there is a strong relationship between economic activities and availability of energy resources [1]. Growing demand of power and degradation of environment has made the power plants of scientific interest for the efficient utilization of energy resources. Electricity generation by coal is one of the most important activities in fossil fuel based economies across the globe. Despite of its significance, the use of coal for electricity generation create

an adverse impact on humans and the environment, especially excessive emissions of greenhouse gases (GHGs) to the atmosphere [2]. As far as electricity generation is concerned, government of every country should develop energy policies in order to use their own resources efficiently, considering the decreasing fossil fuel sources and increasing prices. On the other hand, environmental pollution associated with fossil fuel based power has a serious pressure on ecosystem and human health. Thus, in the design stages of fossil power systems, main objective should be maximizing energy output with minimum fuel consumption [3]. Energy policy is promoting many researchers both for the enhancement of utilization of renewable energy and use of low enthalpy fuels for power generation, including the most effective ways of using them. The use of renewable energy technologies would reduce the current global environmental

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problems as well as the national energy insecurity of many countries dependent on fossil fuels.

Electricity is the prime driver for the economic growth of any developing country like India, which is witnessing a robust economic growth rate of 8% and above. India has huge coal reserves about 7.1% of the world's total [4] and thus, coal-fired power plants contribute to about 70% of the total power generation [5]. India faces a significant gap between electricity demand and supply as reported by the Central Electricity Authority for the year 2009–2010 as almost 84 TWh, which is 10% of the total requirement. The peak demand deficit is more than 15 GW, corresponding to a shortage of 12.7% [6]. The total power generation capacity of India now is 207006.04 MW (Aug 2012). Out of that coal fired thermal power plants have the generation capacity 117833.38 MW and natural gas fired combined cycle power plants have the generation capacity of 18903.05 MW [7].

According to energy, statistic's report produced by National Statistical Organization, Ministry of Statistics and Programme Implementation (Government of India). Per-capita energy consumption (PEC) during a year is computed as the ratio of the estimate of total energy consumption during the year to the estimated mid-year population of that year. Energy intensity may be defined as the amount of energy consumed for generating one unit of gross domestic product. Per-capita energy consumption (PEC) and Energy intensity is the major policy indicators, both at national and international levels. In the absence of data on consumption of non-conventional energy from various sources, particularly in rural areas in the developing countries, including India, these two indicators are generally computed based on consumption of conventional energy. The estimated PEC has increased from 1204 kWh in 1970–71 to 4646 kWh in 2009–10. The annual increase in PEC from 2008–09 to 2009–10 was 11%. The Energy Intensity (at 1999–2000 prices) increased from 0.128 kWh in 1970–71 to 0.165 kWh in 1985–86, but it has again come down to 0.122 kWh (at 2004–05 prices) in 2009–10 [8].

In the present article, authors have focused attention on the current Indian power generation capacity based on different power sources. Future options for undoubtedly offer the most promising environment friendly power generation technologies, which are also discussed in brief.

2. World energy scenario

Renewable energy technologies are considered as clean sources of energy and optimal use of these resources minimize environmental impacts, produce minimum secondary wastes and are sustainable based on current and future economic and social needs [9]. The power generation in green manner may be seen as a means of encouragement for renewable energy resources (RER) [10]. The term green energy is also used for green energy produced from cogeneration, energy from municipal waste, natural gas and even conventional energy sources [11]. No doubt that electric power generation sector in many countries has contributed the huge amount of greenhouse gas emissions, and therefore, a major target of climate changes regulation [12].

Global power generation scenario from all possible sources is presented in Fig. 1. It is clear from Fig. 1 that from 2007 to 2035, world renewable energy use for electricity generation grows by an average of 3.0% per year, and the renewable share of world electricity generation increases from 18% in 2007 to 23% in 2035. Coal-fired generation increases by an annual average of 2.3% in the reference case, making coal the second fastest-growing source for electricity generation in the projection [13].

There are a number of scientists and researchers across the world striving for sustainable development. A comprehensive

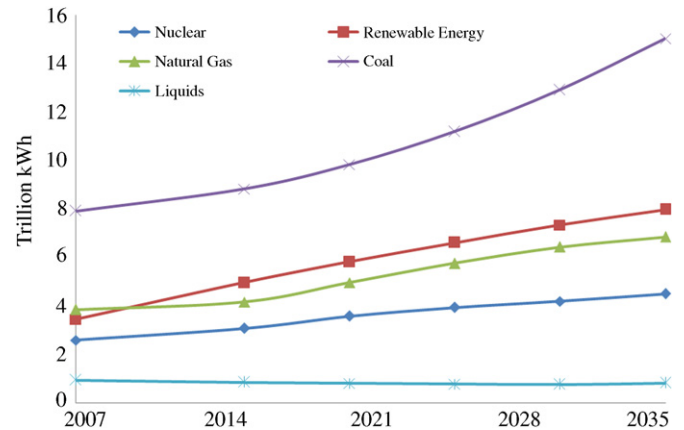


Fig. 1. World net electricity generation by fuel (Trillion kWh) during 2007–2035 [13].

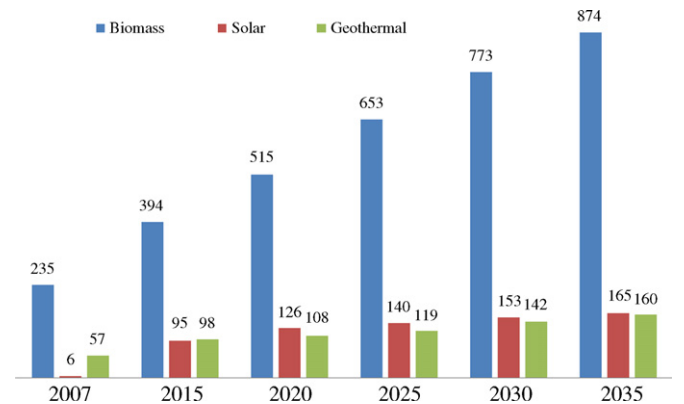


Fig. 2. World renewable electricity generation by energy source, excluding wind and hydropower, 2007–2035 (billion kWh) [13].

definition for sustainability was worked out for the first time by the Brundtland Commission, adopted by the Rio Conference 1992, and has since been refined, and interpreted. The Brundtland report defines sustainable development as a development that “meets the needs of the present without compromising the ability of future generations to meet their own needs”. Energy plays a crucial role in sustainable development [14]. The sustainable development is possible only when there is optimum use of renewable energy sources. Global prospects of renewable energy application for electricity generation show that, much of this is fueled by hydropower and wind power. Fig. 2 reveals that the 4.5 trillion kWh of increased renewable generation over the projection period, 2.4 trillion kWh (54%) are attributed to hydroelectric power and 1.2 trillion kWh (26%) to wind. Except for these two sources, most of the renewable energy technologies are not economically competitive with fossil fuels over the projection period, outside a limited number of niche markets. Typically, government incentives or policies provide the primary support for construction of renewable generation facilities. Although they remain a small part of total renewable power generation, renewable other than hydroelectricity and wind including solar, geothermal, biomass, waste, and tidal/wave/ oceanic energy does increase at a rapid rate over the projection period.

3. Indian power scenario

India's net cumulative installed power generation capacity from various sectors is 207006.04 MW (Aug 2012). Fig. 3 reveals

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